SCALE AND MODE IN THE MUSIC OF THE EARLY TAMILS OF SOUTH INDIA

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The Tamils trace their lineage to the ancient Dravida people of South India, whose territory at one time covered the southern third of the Indian subcontinent and large portions of northern Sri Lanka. Tamil is now spoken by more than fifty million people, located mostly in the state of Tamil Nadu (whose capital, Madras, is now known by its traditional Tamil name, Chennai), with smaller concentrations in the neighbouring states of Andhra Pradesh, Karnataka and Kerala, as well as Sri Lanka and various countries of Southern Asia. Tamil culture flourished during the first millennium of the common Era and is known largely through its epic literature, which has been rightly compared to the Sanskrit epics *Mahabharata* and *Ramayana,* and to the *Iliad* and *Odyssey* of Homer.

The ancient musical tradition of the Tamils was highly developed and supported by an extensive, detailed and explicit body of musical thought - of which one of the most striking features is a set of scales and modes that resemble those of various ancient mediterranean civilizations, but were derived and explained in fundamentally different ways. At the same time, the Tamil musical system has much in common with the musical system recorded in early Sanskrit treatises.[1] What happened to the indigeneous musical culture of the early Tamils is not clear - whether it (1) became contaminated and eventually replaced by the music and musical ideas brought by the successive waves of Indo-Aryan settlers from the north, or (2) was driven underground and preserved as a secret tradition, or (3) evolved gradually into the tradition of Carnatic music practiced in South India today. The latter differs radically from the Hindustani music heard in the northern two thirds of the subcontinent, because of its relative freedom from Persian influence. But any links between Carnatic traditions and the Tamil system described and analyzed in the following pages are, if not broken, at least greatly attenuated.

That no living repertoire has survived is no reason to regard the great ancient theoretical systems as mere historical curiosities. Their teachings are both a fossil record of the music form which they arose and a tribute to human ingenuity in formalizing the sensuous world of musical sound and translating in into concepts that can be taught, learned, and remembered. And they are interrelated: in the case of Tamil music, there are probable connections to the ragas of modern South India, as well as possible historical

links with the musics of neighbouring West Asia and the eastward spread of India culture throughout the Southeast Asia mainland and archipelago. Each new piece of evidence helps us refine our thinking about human musical preferences and the ingenious ways in which we have constructed complicated pitch systems - just as recent evidence for possible life forms on another planet compels us to call into question some of our most basic assumptions about the nature of life and the history of the universe.

As a music theorist, I am willing to make only two assumptions about music - that there is organization in what I hear, and that it is my business to find it. In the following pages I examine some provocative early evidence for what music theorists do when they attempt to make sense out of raw musical data, when all our instincts urge us to seek out pattern, grammar, and logic in the music we hear. I cannot think of a problem more central to the dsicipline of music theory than the concept of mode. The rise of early modal systems remains one of the great half-told stories in the history of music, and our confidence in the inevitability of the systems and grammars of pitch organization in Western music is shaken - or ought to be shaken - whenever we come in contact with the radically different scales and modes of the old high musical cultures of Asia. In this article I propose to revisit some of the basic questions, hypothesis and arguments about scale-building in world musics, drawing upon the great Tamil epic, the *Cilappatikaram.*[2]

In any representative sampling of ancient musical systems, the presence of certain common features and tendencies cannot be ignored, among them (1) the strategic placement of stable intervals such as the perfect fourth and fifth; (2) the frequency with which similar pentatonic and heptatonic collections turn up again and again; (3) the tendency to rotate these collections, providing variety and flexibility; and (4) the tendency to assign modal functions (e.g., initial, final, axial, predominant, profuse, scarce) to stable and unstable scale degrees. But here is a problem. These so-called universal stop far short of explaining all the distinctive, colorful local features we hear in modal systems from around the world. Common sense tells us that musical organization must draw upon *some* natural laws; but experience makes us wonder how vague and general these laws must be to become manifest in such different repertoires and cultural contexts. For me, one of the most important understandings about music arises from our recognition and savor of the special blend of cultural diversity and basic human instincts we hear in various world musics. We shall encounter such a mixture in the music of the early Tamils.

I conclude this introduction with some observations on comparing musical systems. Translating musical behavior into musical concepts is, among other things, what music theorists do. From an anthropological perspective, it can be argued that this is at times a completely unnecessary and useless exercise. Music making does not require musical concepts any more than verbal communication requires grammar, cases, tenses, conjugations, parts of speech and syntax. But when music reaches a certain level of sophistication, we feel an almost irresistible urge to bring it into some kind of systematic order.

Musical systems become formalized in several phases. Phase one is concerned with differentiating between notes, naming them, counting them, measuring their distances from one another, and arraying them in some order. This is a fascinating phase that often consists of several stages, but the present study focuses on phase two-how the basic sets are organized into a system. Most obviously, some cultures never progress beyond phase one, and others do not make it that far.

I distinguish between four terms in the following pages: diatonic, heptatonic, pentatonic and anhemitonic. The *diatonic* collection (set class 7-35) is heptatonic by definition and consists of two small and five larger steps, with maximal separation between the smaller steps. The term *heptatonic* signifies any seven-note scale, although most of the references in this article will be to the diatonic versions; it appears here when I emphasize the number of notes, not their pattern. The term *pentatonic* signifies any five note scale, but all references in this article are to the familiar *anhemitonic* pentatonic (set class 5-35): three small (M2) and two larger (m3) steps, with maximal separation between the larger steps.

Example 1 is a comparative display of the findings of two recent studies in which diatonic set theory is applied to the pitch systems of various ancient musics.[3] I have added comments in which I take the liberty of paraphrasing the studies' conclusions in order to demonstrate underlying similarities. We shall soon see how ancient Tamil musicians addressed these issues. My agenda includes the following topics:

1. the basic assumptions of the system.
2. modal functions and their relative strength.
3. which modes, scale patterns and degree sequences are preferred.
4. generation and rotation procedures,
5. the special role of perfect intervals, and

6. the relationship - if any - between nested collections, such as the intriguing nesting of 5 within 7 within 12 within 22, which we will examine shortly.

The next task is to sketch out what is known about the Tamil modal system. To facilitate comparisions, I have substituted equivalent Western terms wherever possible, and I have attempted to restore what has been lost in local color in the accompanying commentary and notes. What follows should be taken as an example of a musical system that could have arisen in any part of the world, or, as Gauldin has playfully suggested, on another planet![4]

Example 1. Findings of two applications of diatonic set theory to ancient pitch systems.

Gauldin 1983 (43-44), four conditions for a "viable hierarchical tonal system":

1. variety of distinct subset interval classes as compared to the cardinality of the set
2. distribution of ic occurrences, thereby leading to norm/deviant relationships.
3. a high frequency of stable acoustical intervals (especially P4/P5), which are useful for such things as tuning, tonality and modulation.
4. a modal system that permits both (a) a choice of different key notes and (b) a realignment of functional relations around the reference tones

Comment: In other words, a good system features a variety of distinct intervals with uneven distribution (frequent/ambiguous to unique/certain), acoustical stability and rotation without pattern duplication.Undesirable properties include equal partitioning, symmetry, few and uniform intervals, and the absence of modality.

Clough et al. 1993 (55-57), six "defining features" of the diatonic and early Indian *grama* systems:

1. exactly one tritone
2. dual tetrachords
3. distinct step sizes which are consecutive integers
4. distinct sizes of fifths which are consecutive integers
5. a maximal number of consonant fifths
6. first- or second - order maximal evenness (as defined by Clough and Douthett 1991)

Comment: In other words, a good system ought to be defined by one distinctive interval, balanced (around one axis or point of focus), ungrapped, acoustically stable, and as maximally even as possible (that is, each generic interval occurs in just one size or in two consecutive sizes). Desirable properties include definition, balance, distribution, stability and evenness, with the aim of insuring a complete set of discrete rotations.

There are, to be sure, reasons why this system arose in India, and I shall not neglect them.

Scale and mode in the *Cilapatikaram* and its commentaries

Most of what is known about the musical system of the Tamil comes from their most cherished literary treasure, the *Cilappatikaram* [The Story of an Anklet], and its two principal commentaries.[5] Its title refers to a love token given by Kovalan (the hero) to his wife Kannaki, which subsequently-like Desdemona's handkerchief and Sakuntala's ring - becomes the central symbol of a tragic rule of love gone wrong. Because of its many lyrical episodes, the *Cilappatikaram* portrays a somewhat gentler world than that depicted in the *Iliad* and the *Odyssey,* apart from one grisly scene in which the abandoned Kannaki lays a curse on the city of Madurai by tearing off her left breast and casting it to the ground, after which the breast bursts into flame and engulfs the entire town, sparing the righteous while punishing the evil-doers.[6]

Authorship of the epic has been ascribed to the otherwise unknown poet Ilanko Atikal, who lived during the second century C.E., but there is absolutely no evidence to confirm such an early date. The translator, R. Parthasarathy, suggests the fifth century as a more likely date of origin.[7] The *Cilappatikaram* consists of 5,730 lines in the standard meter of Tamil epic poetry (*aciriyam*), with occasional excursions into other meters and a few prose passages.[8] It is divided into twenty-five cantos and five song cycles, distributed into three books that represent "the three distinct phases through which the narrative moves - the erotic, the mythic, and the heroic."[9] The work was written at a time when the Aryans from the north were making their way farther and farther into the southern areas of the Indian subcontinent, and its material almost certainly reflects the cultural friction between indigeneous Dravidian musical concepts and the Sanskrit system brought by the new settlers.

The *Cilappatikaram* is far from a technical treatise, but some of the passages on music contain extremely detailed information. The following account of the Tamil modal system is woven around five text passages (reproduced here as Texts 1-5) and amplified by information from the two commentaries (as discussed below). While the

focus of the present article is upon interpretation and not textual matters per se, it will be useful to point out what we mean, in this case, by the "text." The *Cilappatikaram,* like other major epics of the ancient world, existed as a flexible oral text long before it was edited and set down in the form in which we have received it. We do not know the age of the musical system whose details it records. The most that can be said is that the Tamil system apparently arose as an independent tradition, but subsequently came under the influence of the central Sanskritic musical tradition, with which it shared or came to share many common features. Parthasarathy remarks that "By the time of the poem, northern Sanskritic ideas had become a part of the Tamil worldview." and the same can be said of the musical concepts set forth herein.[10]

The prevailing interpretations of the musical details depend heavily upon the commentarial tradition, particularly (1) an anonymous ninth-century glossary entitled *Arumpatavurai* (The Meaning of Difficult Words) and (2) the twelfth-century commentary by Atiyarkkunallar.[11] Both sources included quotations from earlier commentaries, so their material is a composite of several historical layers - a common occurrence in early Indian literature. It is generally assumed that the musical system described in the *Cilappatikaram* and its commentaries evolved directly into the Carnatic musical tradition of modern South India, but that process is no clearer than is the similar process by which the ancient system recorded in early Sanskrit music treatises evolved into today's ragas and raga systems. For those who are understandably hesitant to place their trust in reconstructions of past musical practice that are based solely on written evidence, it is important to point out that the basic details of the Tamil system have also been handed down in the form of a continuous oral tradition, and that no other credible interpretations have survived. And, because of its internal consistency, if any of it is wrong, it is all wrong!

The musical references in the main text and the two commentaries are few and far between, but they are remarkably explicit. The commentators appear to have had two common objectives: to amplify the musical references in *Cilappatikaram* with technical detail, and to point out the ways in which the Tamil system resembled (or had come to resemble) the main Sanskrit musical tradition. The latter is, of course, both a musical and a political issue. But the manner in which the commentators reconciled their two, often contradictory, goals gives us some reason to trust their objectivity: if they had been ardent Tamil nationalists, they would not have been likely to link their music with the Central Indo-Aryan tradition; and if they were writing as early ethnomusicologists reporting on an exotic, provincial music, they would scarcely have

written in Tamil and demonstrated so much understanding of the local features of Tamil music and culture.

Our "text," then, consists of a written core and a body of supporting evidence, both oral and written. There is no doubt that some scholars have failed to keep separate the core and its surrounding layers, as, for example, when Parthasarathy chose to replace the original Tamil names for the seven scale degrees with the Sanskrit sol-fa syllables (see Text 3 and Example 3).[12] S. Ramanathan's study, *"Music in Cilappatikaram"* which was first presented as a Ph.D. dissertation at Wesleyan University in 1974, is a welcome exception and the primary source for the following analyses and interpretations.[13] Ramanathan had been working on this material since the 1940s, and I have heard nothing from Indian colleagues who are currently studying Tamil music that calls into serious question his textual scholarship or musical interpretations. While I take exception to Ramanathan's claim that the intervals of the scale fell into just ratios (such as 9:8 and 10:9), for reasons I shall detail, I believe that he is otherwise on firm ground and represents faithfully the tradition of ancient Tamil music - so far as it can be known.

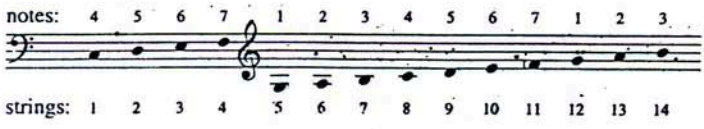
Modern scholarly interest in the Tamil literary classics developed in the second half of the nineteenth century, resting especially on the pioneering efforts of Uttamatanapuram Venkatacuppiramaniya Caminataiyar [1855-1942] who, according to Parthasarathy, "redrew, very much on his own, the literary map of India in the late nineteenth century."[14] It was he who prepared the first critical edition of *Cilappatikaram* and its commentaries (1892), based upon eight manuscript copies of the main text and fourteen of Atiyarkkunallar's commentary.[15] More recently, the epic has appeared in atleast three other Tamil editions and has been translated into Czech, English, French, Hindi, Malayalam and Russia.[16]

Apart from S. Ramanathan's study, I am not aware of any detailed study of the Tamil musical system prior to Sister Margaret Bastin's recent University of Madras thesis, which has not been available to me but in which I understand she subscribes generally to S. Ramanathan's conclusions and interpretations.[17] Neither the "India" or "Mode" articles in the *New Grove* includes any information on this topic, nor is there a separate entry for Tamil music. My contribution in this study is to examine this material from the point of view of a Western musicologist, against the background of Western concepts and categories and providing appropriate analyses, with the hope of testing many of the generalizations that have been made about the universality of the idea of mode.

The following discussion is based on the four most important musical passages from *Cilappatikaram* (reproduced here as Texts 1, 2, 3 and 4, pp. 188-190), as amplified in the two commentaries. A fifth passage (Text 5) appears at the end of the article. I have not reproduced the text of the commentaries, which consist of either terse definitions or close paraphrases of the main text.[18]

Texts 1 and 2 contain important information on tuning procedures and the musical gamut, although it is never obvious whether "the first," "the second," and the other ordinal numbers refer to strings or notes of the scale. The yal (or *yaazh* in another popular Tamil transliteration system) is often referred to as a harp because of the large number of strings, but the movable bridge and leather frets described in the first text indicate that it may actually be a lute, despite the apparent tuning by steps. The *Cilappatikaram* mentions yals with seven (Text 1), fourteen (Text 2), nineteen and twenty-one strings. Example 2 is a tentative reconstruction of the gamut.[19] All pitches were relative, so the entire system could be transposed to accommodate one's vocal range. In each text, I have taken the phrase "beginning with the fourth and ending with the third" to refer to scale degrees, not strings.[20]

Example 2. The gamut on the fourteen-stringed yal (Texts 2 and 4)



To continue with comments on Texts 1 and 2. The reference in Text 1 to a mode that is pentatonic in ascent but heptatonic in descent is also an accurate description of modern Carnatic and Hindustani practice, in which the opposite is rarely true. Lines 34-37 of Text 2 provide a clear description of tuning practice in which harsh (cempakai), sharp (arppu), and flat (kutam) notes are corrected, along with beats (atirvu, trembling). I am at a loss to explain lines 40-42 of this passage, unless the intent of the author was simply to establish the relationship between the strings and the scale steps. On the other hand, lines 43-46 of the same text - however they are interpreted - suggest some sort of preliminary exercise to establish the basic tonality.

Example 3. The diatonic scale

numbered scalesteps	Sk. sol-fa syllables	Tamil names	meaning of name (?)
1	sa	kural	resounding
2	ri	tuttam	fragrant
3	ga	kaikkilai	unrequited love
4	ma	ulai	place
5	pa	ili	laughter
6	dha	vilari	tender
7	ni	taram	highest

Example 3 supplies the Tamil names for the notes of the scale, their meanings (from which certain inferences are possible), and their equivalents in the Sanskrit *sargam* sol-fa notation.[21] In all cases of which I am aware, the original text of the *Cilappatikaram* provides only the Tamil names; the sanskrit sol-fa syllables appear only in the commentaries.

Texts 3 and 4, along with their accompanying commentaries, permit us to infer two different versions of the Tamil modal system - an Old Tradition (Examples 4 and 5) and a New Tradition (Example 7) - and their tuning. The round dance of the young girls described in Text 3, in which each girl represents one of the seven scale degrees, is perhaps the most memorable image among the musical passages of the *Cilappatikaram,* and circular projections of various types dominate the musical imagery of the Tamil system.[22]

Readers will see at a glance that the Tamil scales were diatonic, with none of the chromatic tunings of the Persian scales to the west, and no hint of the equidistant scales and more restrictive sets of modal rotations heard today in various regions of Southeast Asia. For our purposes, the most appropriate comparisons are to the modes of the medieval Roman Catholic Church and the scales of ancient Greece and India. In this connection, two points should be made here. First, there are no indications that similarities among these musical systems are the result of the spread of culture from one region to another; there were cultural contacts between Indian and the ancient Mediterranean world long before Alexander the Great invaded northern India in the fifth century B.C.E., but the scales and modes described in early Sanskrit treatises were conceived in such a radically different way that the differences far outweigh the similarities.[23] And second, all the surviving evidence for early Indian music is verbal: any diagrams, pictures, or other visual representations of the musical data have been devised by later scholars.

Text 1 (13:131-41)

He took up
A seven-stringed lute and tuned its scale
By tightly fastening the leather straps
On the curved arm. He placed the bridge
Along the fingerboard, and tuned the strings
Beginning with the fourth and ending with the third.
On his ear he then tested the mode
That had seven notes in its descending scale
And five in the ascending, and was dear to the goddess
Of the leaping stag. He played it
With three variations according to tradition.

SR texts 107-112

The distinctive features of the Tamil modal system include (1) the particular selection of modes, (2) their circular projection along the twelve houses of the Zodiac, which seems like an attractive possibility for scale-building but one that I have not found anywhere else in the world, and (3) most intriguing of all, the apparent contradiction between the various nested divisions of the octave: into twenty-two microtones, twelve chromatic "houses," seven diatonic scale degrees, and a further selection of five pentatonic degrees.[24] I shall attempt to explain this contradiction and identify the reasons for these numbers in the following pages.

Example 4 is an overview of the Old tradition, translated into Western staff notation and Western modal categories. Example 5 is a comparative display of the four authorized heptatonic modes projected against the twelve houses of the Zodiac - a visual representation of the system as presented verbally in *Cilappatikaram* and its commentaries. Each example will be discussed in turn.

The basic scale of the Old Tradition was palaiyal, a mixolydian scale. *Palai* is an important Tamil word, meaning first *desert*, then a seven-leafed plant or tree that grows in the desert regions of extreme South India, and finally, the heptatonic scale. The compound palaiyal signifies both the basic scale of the Old tradition and the first mode (pan) displayed at the top of Example 4.

Both the Old and New Traditions featured (1) the familiar heptatonic diatonic scale, with the same pattern of steps and steps sizes (of two, three or four microtones)

Text 2 (8: 29-48)

.... she took up the perfect lute
In her hands and sang a sweet song.
Entranced, she played it on the lute.
Bending the thumb of her right hand
And touching the neck with four fingers,
She gripped the screw-pins with the four fingers
Of her left hand, and played the cempakai,
Arppu, kutam and atirvu, having learned
To remove, in order, the dissonance. The series
Of fourteen notes she based on impeccable tradition,
Beginning with the fourth, and ending with the third.
She looked for a hint of the notes made
By the second, fifth, sixth and third.
And fourth strings, and played the first note
On the fifth string. Besides, following tradition,
She plucked the fifth and seventh strings,
Beginning and ending with the fouth note
As well as beginning and ending with the first note.
Strictly observing the three levels of pitch.
She performed well the four types of ragas

SR texts 27, 96-102, 105

that prevailed in the Sanskrit *grama* system;[25] (2) circular projection along the twelve houses of the Zodiac, as shown in Example 5; (3) a complete set of rotations, which could be performed in either a clockwise or counter-clockwise direction; (4) generation by perfect fifths, in which each scale degree is situated at the fifth note and eighth house from its predecessor;[26] and (5) the apparent contradiction that I have noted above between the twelve houses and twenty-two microtones of the system.If these values are correct as reported, then each individual house represents two microtones, while scale steps that span two houses were assigned either three or four microtones. I shall propose a solution below.

In the displays of Examples 4 and 5, each pan is conceived as a series of seven notes strung out in consecutive perfect fifths above its birth note. Each subsequent note falls, therefore, in the eighth house from its predecessor (counting the house in which

Text 3 (17, vv.13, 17-18)

13

Matari turned to her daughter and said:
"These seven young girls have each chosen
A bull from the stable and raised it."
She made them stand in the traditional order,
And gave the name of a musical note to each:
Sa, Ri, Ga, Ma, Pa, Dha and Ni. Matari of the fragrant hair
Gave these names which also represented
Clockwise their positions in the round dance.

17

In the circle they took their exact positions,
Held one another's arms with the crab's grip,
And studied the rhythm for the dance. The girl
Who was Sa turned to her neighbor Ri, and said:
"Let us sing the sweet jasmine raga in praise of Mayavan
Who pulled out the citrus tree in the broad uplands."

18

Sa began to sing on a low note,
Pa, on a median note: and Ri, on a high note.
Dha, on a low note, sings for her friend Pinnai.

SR texts 1, 5-25

the note is born and moving clockwise), as shown in Example 5. Palaiyal, for example, is born with its seventh degree (taram/ni) in Leo-on F, as it were. The remaining modes arises in turn as the first note generated from the birth note becomes the birth note for the next mode. The notes shown in the left margin of Example 4 are, respectively, the birth note and first generated note for each of the pans.

Readers who have encountered Richard Crocker's study of the clay tuning tablets from ancient Ugarit may see some similarities here, except that the Hittite modes were apparently rotated from a phrygian scale (the scale that the Greeks knew as dorian), and, if one accepts Crocker's explanation, proceeded by "correcting" each new diminished fifth to a perfect fifth-insteadof viewing the scale as a continuous chain of perfect fifths.[27]

Text 4 (3:71-91)

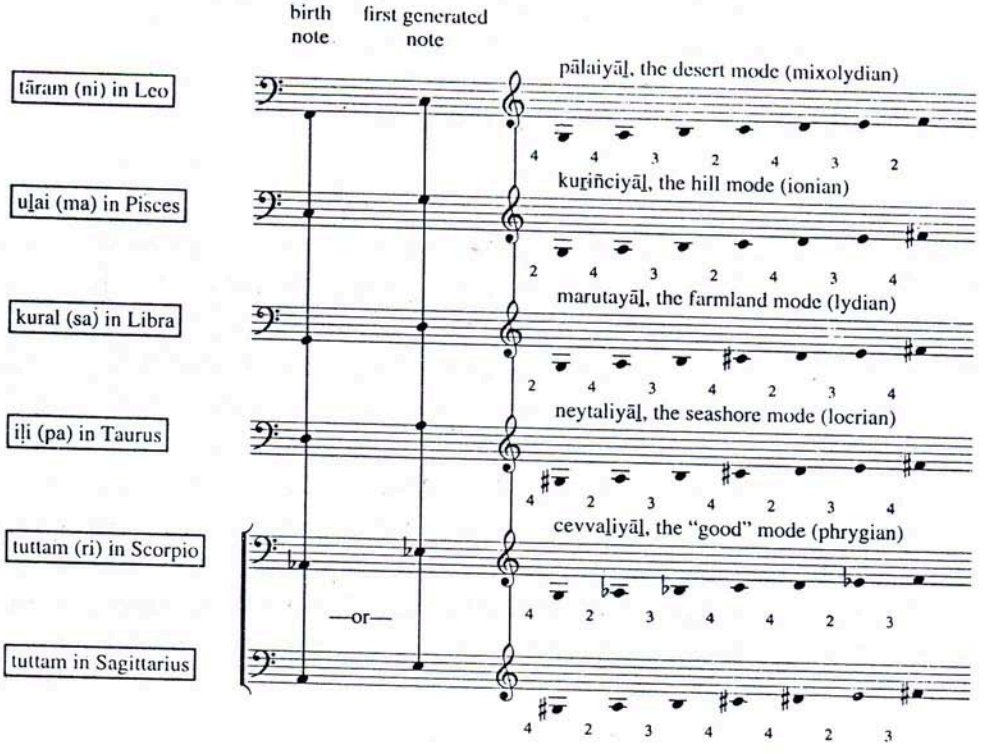
Her lute player was a wizard. To establish
The seven scales within the pattern
Of fourteen notes, he half plucked the low first
And the high seventh to tune the third.
The sixth he produced by the remaining half
Of the elegant and robust seventh which now vanished
Into the third. As the sixth faded, the third
Dissolved with it. Likewise, the rest of the notes
Melted into the others. He played on all
The fourteen strings, from the low fourth
To the high third, and sounded the cempalai
In the new tradition. In order, the scales
Would arise: the patumalai from the third, cevvaḻi
From the second, arum from the first, koti
From the seventh, vilari from the sixth, and mercem
From the fifth. It is thus they were combined.
The notes of the lute got lower in pitch
From the left to the right. With the flute, they got lower
From the right to the left. An expert lute
Player can harmonize the low, high
And median notes to ravish the ear

SR texts 28-31, 44, 80, 120

One colorful local feature is seen in the Tamil names for the modes; the names of the first four are also the names of four of the five types of terrain in South India; the desert (palai), the hills (kurinci), the cultivated land (marutam), and the seashore (neytal). Little remains of the forests (mullai) that covered large parts of South India as recently as a thousand years ago, but that name was reserved for one of the pentatonic modes.[28] While the basic musical scale was heptatonic, its modes could be performed in five-, six, or seven-note versions. It is easy to see how these may have proliferated into a large number of separate ragas (each particularized by its own distinctive set of modal features), of which some undoubtedly survive today. Example 6 is a partial display of the many cultural coordinates of the five principal modes and their corresponding landscapes, providing a romantic context for the prosaic details of the musical system.[29]

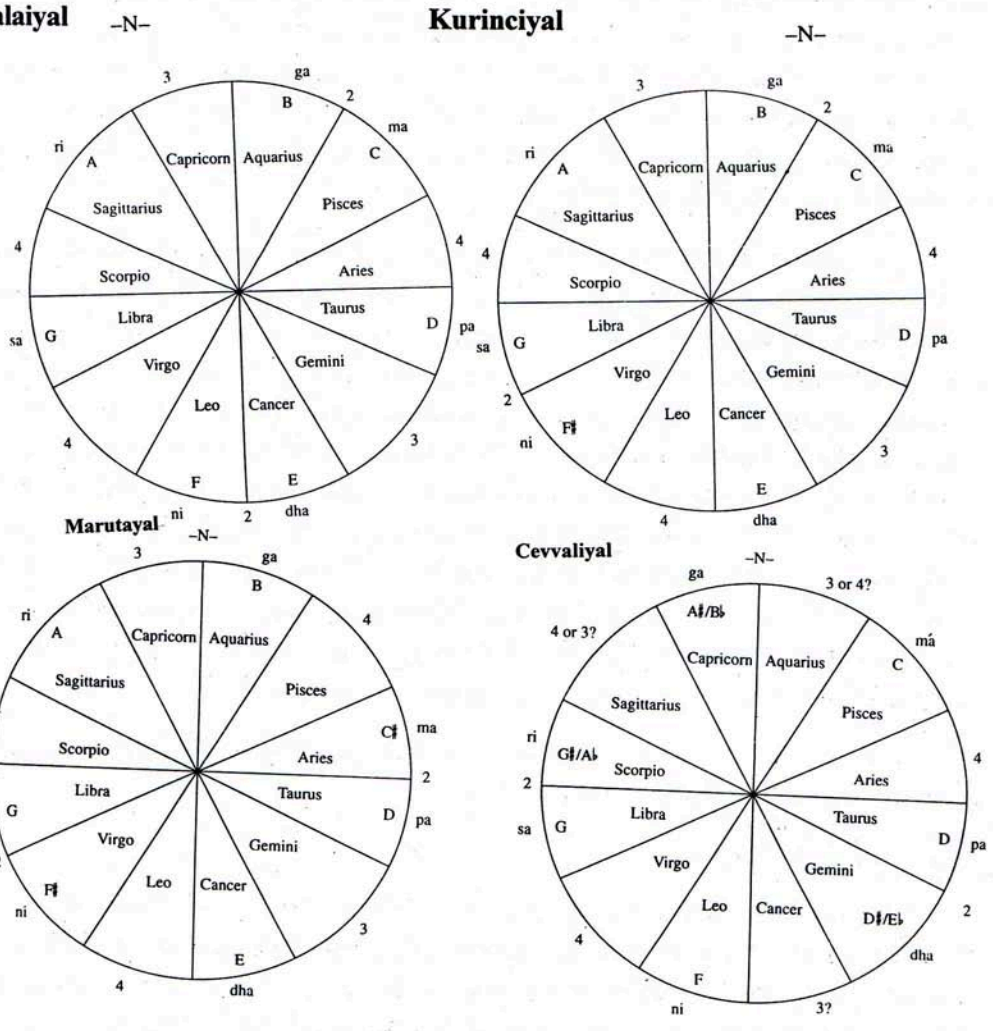
The selection of modal possibilites illustrated in Example 4 is an interesting one: the basic mixolydian (from which the rest arise in turn by fifth generation), an ionian, a lydian, then a locrian (which was rejected), and - after some effort - a phrygian. Two interesting things happen as the process of modal rotation unfolds. All goes smoothly until we reach the fourth mode (neytaliyal), but here the last note to be added lands in Scorpio (G) - not Libra (G) - and is thereby disqualified. It will surprise no one to learn that a locrian construction is rejected as "impractical," but here is where the early Tamil theories began to be really inventive. They needed another mode and had two choices- the two versions of phrygian bracketed at the bottom of Example 4. Of these, the upper version is probably the correct solution: cevvaliyal is born with its second degree (tuttam/ ri) in Scorpio (G or A♭), which returns the "tonic" note to its proper position in Libra.[30] The decision was obviously a trade-off between (a) continuing the strict process of generation and rotation and (b) retaining the tonic note (kural/sa) in Libra. An atypical solution to a typical modal quandary! I must point out, however, that this solution also calls into question the sequence of microtones, which we have been able to infer from the preceding modal rotations.

Example 4. The five heptatonic modes (pans) of the Old Tradition



The "tonic" note (*kural* or the Sk. sol-fa *sa*) remains in Libra, on G as it were, throughout the scalar projections of Example 4 and the circular projections of Example 5. When I use terms such as *tonic* and *final* in the following pages, readers should bear in mind that the musical meanings of these terms do not necessarily coincide with their range of meaning in Western modal theory and practice. In particular, I use the term *tonic* with reference to the indexical role of a particular note, not its musical role as a generator of the other notes or a ground tone toward which the other notes eventually gravitate.[31]

Example 5. Circular projections of the four authorized heptatonic modes



The circle diagrams in Example 5 present the same information as conceived from a Tamil perspective.[32] I have included only the four authorized modes. The seven pitch-class letters inside the circumference of each circle mark the houses into which each of the diatonic scale degrees would fall. There is no information whatsoever in the Tamil sources that would suggest any link between musical qualities of the modes and the astral connotations of the houses of the Zodiac. The astronomical basis for this material is largely dependent on Greek and Babylonian science and does not reflect an independent native tradition; the Tamil names for the houses, with a few exceptions, are literal translations of the standard Western names.[33] For the sake of brevity, I have given the sol-fa names for the notes outside the circle, in preference to the longer and less familiar Tamil names. The Arabic numerals indicate the number of microtones in each interval of the scale.[34] But there is something vitally wrong here: the zodiacal displays in Example 5 obviously cannot represent both 22-tone and 12-tone equal temperament at one and the same time! This is the same contradiction I have noted above and will attempt to resolve below.

Circular projections of the scale and generation by perfect fifths go hand-in-hand in world musics, and here is one aspect of the Tamil musical system in which their modal thinking had more in common with ancient Mediterranean civilizations than with the mainstream Indian tradition of *jatis* and *gramaragas*.[35] With the sole exception of Matanga's projection of the diatonic scale around a circle superimposed on a nexus of six vertical and five horizontal lines, there is absolutely no mention of either circular projections or fifth-generation in the main tradition of Sanskrit musicological treatises.[36] Other metaphors of circularity abound in Sanskrit music treatises, but perfect fifths are mentioned only in connection with the consonant relationship that exists between the predominant note in a raga (the *amsa* or *vadi)* and a note that is situated either nine or thirteen microtones above or below. And it is important to point out that the quality of consonance, in this case, is vested in the note, not the interval.[37]

The next task is to examine the numbers with which these scales were constructed and see what can be determined about their tuning.

The Tuning Problem

The sytem we have been exploring is based on a series of nested pitch collections: 5 within 7 within 12 within 22.[38] Of these, 5,7 and 12 have long been recognized as stages along a familiar numerical pathway. These numbers have turned up time and time again in too many parts of the world to be attributed either to cultural diffusion or

to coincidence. They have their own magic, of which a part must be their mutual affinites. Twelve has proved as useful for music as it has for trade, because of its many divisors and simple ratios. Seven and five are sacred numbers in many cultures, perhaps because they *cannot* be easily divided, and their numerical properties are well known. So part of the appeal of certain numbers lies in the ease of calculation they permit, and another part in the resistance they offer to easy calculation. A paradox indeed! (Recall that many ancient and medieval Western scholars preferred superparticular interval ratios because they could not be divided into two equal parts.) And the number ten, which one would suppose to be especially valuablly for purposes of calculation, is virtually unknown in the history of musical scales.

But why 22, and what is its special relationship with 12 and 7? I know of no other tuning system in which 22 is a significant number. Unlike 5,7 and 12, 22 is not a special cardinality - that is, one that consists of no more than two distinct step-interval sizes,[39] Of the larger numbers that have appeared and continue to appear in proposals for musical tunings, 19 and 31 have often been singled out for praise, but not 22![40] It seems to me that the musical value of the number 22 must lie not so much in its usefulness for subdividing the pitch spectrum into smaller microworlds, but in its ability to represent the pitch relationships inherent in the diatonic scale. This, in a nutshell, is my contention.

The scale notated in Examples 4,5 and 7 consist of three interval sizes (of 2,3 or 4 microtones), deployed in a pattern that can be nothing other than the diatonic scale. We find the same set of microtones in both the Tamil scales and the scales of the central Sanskrit tradition of anceitn and medieval India. They are called *sruti* (literally, "that which has been heard") in Sanskrit and *mattirai* (measure) in Tamil.[41] Most musical systems permit the independent use of the smallest identifiable interval; these do not. The interval of one microtone exists only as the measure of difference between one tuning and another. It cannot be directly perceived, only inferred (a typical postulate in the Indian philosophy of perception).

No one has suggested that the early Tamil system was a 22 tone equal temperament, but thinking of it in this way will help us compare the interval sizes. Measured in the system of centitones (1200 per octaver) devised by A. J. Ellis, 1/22 of an octave equals about 55 cents. The interval of 2 microtones, therefore, sums to 110 cents- a remarkable approximation of its counterpart in just intonation, the diatonic semitone or "leading tone" with a ratio of 16:15 (112 cents). So far, so godd. But the

two generic wholetones of the Tamil system (the intervals of 3 and 4 microtones) contain 164 and 218 cents, respectively. Their just equivalents are 192 (10:9) and 204(9:8) cents.

S. Ramanathan and many other Indian authors have contended that in practicee these intervals graviated toward "natual" ratios such as the 9:8 and 10:9 whole tones of just intonation,[42] but I am not persuaded by their arguments. Indian ears are far too sharp, and Indian mathematicians (who were the first to devise the concept of zero) were too sophisticaed with numbers to have assumed these step sizes without comment.[43] To argue against exact tunings and specific sets of interval ratios is not to disparage a culture's ability to render small intervals with precision. The following two arguments seem to me to be the most persuasive. First, in a mathematically sophisticaed culture such as India's, when a case for specific interval ratios has not been made in the musico logical literature, it cannot be assumed or justified by an appeal to nature. And second, when the basic concept of interval is not fully developed (as in most of the traditional music of South, Southeast, and East Asia), no one should be surprised that a consensus on interval tuning has not emerged.

We must at least consider the possibility that early Tamil musicians had found an appropriate set of measures for what they played and heard. It may boggle the mind to conceive of a scale with two whole steps of such dissimilar size, and we may rightly ask what then is the distinction between a semitone and a "tone"? But this, I suggest, brings us closer to understanding the nature and special allure of diatonicism. Ptolemy of Alexandria distinguished between five diatonic tunings, some of them as seemingly bizarre as this one[44]. In only one of the five, the Pythagorean "ditonic" diatonic, do we find two identical whole steps (9:8, 204 cents). I find that the Pythagorean version of diatonicism smacks more of theoretical ingenuity than of a musical preference. It has obviously become a mucial preferene in many parts of the world, but convenience and habituation can train the ear to prefer just about anything we want it to prefer. For me, the special appeal of the diatonic scale lies in the certainty of reference it provides within a highly flexible and yet easily calculable system. There is abundant evidence that earlier Western versions of diatonicism relished the subtle distinctions between secundal intervals, distincitions that later practice has all but rendered obsolete.

To draw this argument to a close, let us return to the pathway of magic numbers. What I have been referring to as the main stream Sanskrit musical system proceeded direcly from 22 microtones to the 7 degrees of the diatonic scale, in precisely the

pattern illustrated on the top line of Example 4. The twelve-tone chromatic existed only as a theoretical possibility, to be demonstrated by comparing different scales on a stringed instrument such as the vina.[45] Authors of musical treatises did not describe an octave with twelve equivalent semitones until the thirteenth century, and that -for practical pruposes -was the end of 22. But the 22 microtones continued to be mentioned in the treatises as an ancient tradition, and also the reason why certain of the twelve chromatic steps were shaded up or down from their basic position, especially up! (The concept of sharp is present in the earliest layers of Indian musical thinking, but the concept of flat was very slow to develop.)[46]

Here, then, in the early Tamil system, is the only mention of the complete pathway of numbers; from 22, to 12 to 7 -and, as we shall soon see, on to 5. As I (and co-authors) have remarked elsewhere, it may reflect a political compromise between the ways in which the local Tamils and the encroaching Indo-Aryans conceived and heard their music.[47] I think we have not fully realized that the history of musical tunings is at the same time a history of politics, imperialism, colonialism, resistance, and submission, in which there were both winners and losers,[48] We delude ourselves if we believe that some musical systems disappear and others survive solely on the strength of their intrinsic excellence or the ingenuity of their proponents.

The scale and modal constructions of the Tamils appear to validate- at least in part- the concept of maximal evenness which John Clough and Jack Douthett have been developing in a series of recent articles, of which one of the cardinal principles is that each generic interval is expressed in just one or two sizes of consecutive integers.[49] Each step along the pathway of numbers from 22 to 12 to 7 to 5 can therefore be descirbed as a maximally even derivation from the larger parent collection. The pathway itself appears to satisfy the exacting set of conditions in Clough and Douthett's award-winning 1991 article.[50] To put it in a simpler way, the distribution and relative sizes of the small intervals in a 22-note collection match remarkeably well what I believe to be the basic pattern of, and human preference for, diatonicism.

It must have taken quite some ingenuity to consturct this system, and it is not clear whether it was all in place at one time, or is a composite of several historical layers. As I have pointed out above, the zodical diagrams in Example 5 cannot represent both 22-tone and 12-tone equal temperament. If we examine these diagrams from the perspective of Clough and Douthett, it turns out that a 22-pitch-class system generated by ascending perfect fifths can be reduced direcly to a 12-pc system-one in which each of the 22 pcs falls *within* the proper house and in which, therefore, 12-note chromatic

universe might have arisen logically in leveling out the differences betweeen the smallest intervals.[51] This would have involved "correcting" Pythagorean commas, but the scholars of ancient India had no concept of enharmonic equivalence, nor did they conceive of distinct intervals or interval classes per se. An interval of 9 or 13 microtones might indicate a consonant relationship in certain contexts, but not in others.

This is about as far as I consider it prudent to speculate on the tuning of the early Tamil system, although I will return for some concluding comments in the final section of this article. Readers may note that I have yet to explain the special role of the number five in Tamil music and culture, of which Example 6 has provided a foretaste. The derivation and structure of the Tamil pentatonics will be the final topic of the next section.

Example 6. Cultural Coordinates of the five landscapes

landscapes	hills	forests	farmland	seashore	wasteland
musical modes	kuṟiñci	mullai	marutam	neytal	palai
times of day	dead of night	evening	morning	sunset	noon
seasons	cool season, season of morning dew	rainy season	all seasons	all seasons	summer
phases of love	meeting, lovers' union	waiting	sulking, un faithfulness	anxiety, separation	parting, hard-ship,elopement
characteristic flower	conehead (kuṟiñci)	jasmine (mullai)	queen's flower (marutam)	dark lily (neytal)	ivory wood tree (palai)
water	waterfall	river	pool	well	stagnant water
people	hill tribes	herders	farmers	fishermen	bandits
beasts	elephant	deer	buffalo	crocodile	tiger

Rotation, The New Tradition and The Pentatonics

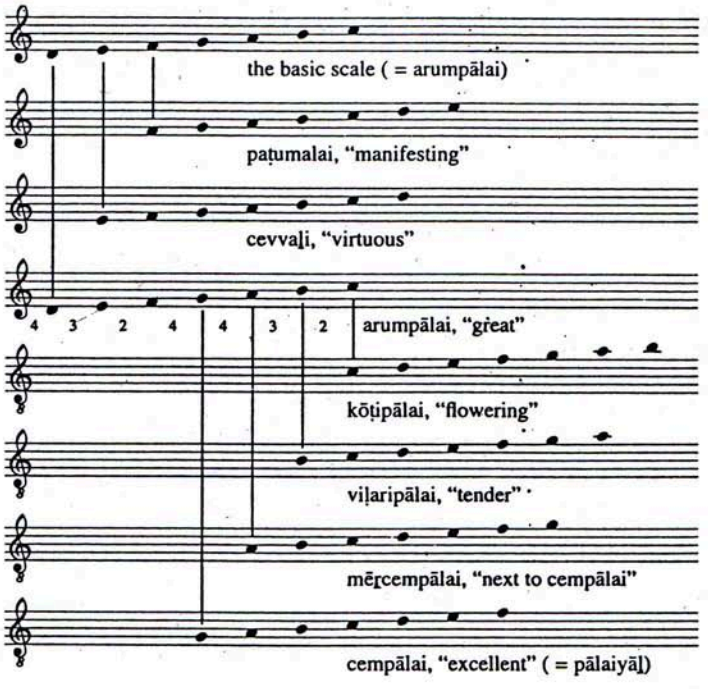
Three remaining features of the Tamil system require our attention. In addition to the pans displayed in Example 4, the system provided for a complete set of diatonic rotations, which I have not diagrammed. From palaiyal, for example, the diatonic patttern was subject to rotation in either a clockwise or counterclock wise direction by shifting the functional names of the notes one position at a time. This process is called *kural tiripu,* a nice expression that means "wandering" or "meandering" tonic. These rotaions seem to have been relatively neutral, theoretical conception that were introduced for the sake of completeness and correspond to the octave species of ancient and medieval Western modality or the Sanskrit *murcchanas.*[52] The interesting point here is the

simultaneous existence of two sets of rotaions; one complete set of generalized rotations through the diatonic pattern, and a more selective and particularized set of modes.

Like the later ragas, the Tamil modes were recognized by clusters of modal features, in addition to their interval pattern.[53] The commentator Atiyarkkunallar mentions "eight actions" by which the characteristics of a mode can be demonstrated; initial, final, scarce, shaking, crooked path, profuse, rolling, and striking-difficult to describe in words but easy to demonstrate in the traditional face-to-face instruction.[54] As was the case in the early stages of the raga system, the concept of a note around which the mode revolved was more important than the concept of final. (Finality does not carry the same weight in the continuous world of cyclical time that it does in the world of linear time.)

I referred earlier to the so-called New Tradition (Example 7), which is the result of the same process of tonic shifting. A dorian scale is now the basis for the successive rotations, the same dorian scale (and, we may presume, the same tuning) that served as the basic scale in the music of the north-the *Sa-grama.*[55] Here again we see an example of the powerful mixture of modes and politics that Plato pointed out in the fourth book of *Republic.*[56] This is the system described (none too clearly) in lines 79-86 of Text 4 and clarified in the *Arumpatavurai.*[57]

Example 7. Modal rotations in the New Tradition

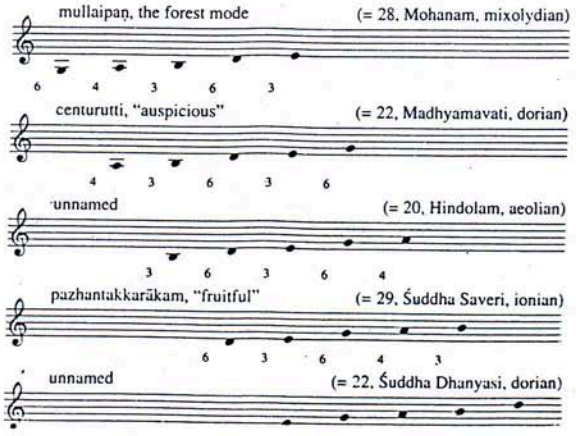


To make it work, first play the 14-note gamut (Example 2) and then palaiyal in the Old Tradition, which becomes cempalai in the New Tradition,a mixolydian on G. From this, find the scale on D called arumpalai (this is the step omitted in the text) and use it as the base for a new set of successive downward rotaions; from the third [degree], from the second, from the first, from the seventh, from the sixth, from the fifth [of arumpalai, followed finally by cempalai from the fouth]. The process is simpler than it appears to be in Example 7; the result is one complete set of rotaions of the mixolydian cempalai., from top to bottom. At some point, the missing step may have been unwittingly edited out of the *Cilappatikaram's* original text or overlooked by a scribe, who like many of his colleagues-may not have fully understood the technical material he was copying.

We lack documentary evidence for the modes that arose from the various rotations of the New Tradition, but the Tamil commentaries put their number at 103.[58] It has generally been assumed that these were the ancestors of many modern South Indian ragas, and I see no reason to suppose that this was not the case.

Finally, the Tamil system provided for a complete set of five pentatonic modes, produced by rotaing the familiar anhemitonic collection. Example 8 is an overview of the Tamil pentatonics which, like the heptatonics, were arrayed along the houses of the Zodiac and proceeded in regular rotation from mullaipan, the forest mode (the pentatonic equivalent of palaiyal). Example 8 also displays their sequence of microtones and the equivalent pentatonic ragas in today's Carnatic music,[59] The numbers in parentheses are the numbers of the equivalent heptatonic scales in the South Indian *melakarta* system that was conceived by Venkatamakhin in the early seventeenth century and has become the thoretical basis for today's Carnatic ragas.[60]

Example 8. A consnectus of the five nentatonic modes



The pattern of rotation reminds us of ancient Chinese practice, in which the basic pentatonic scale was derived by ascending perfect fifth and then rearranged in consecutive steps within the compass of an octave.[61] As a valuable Tamil passage from one of the commentaries puts it, "the notes arising by fifths are five; kural [1], ili [5], tuttam [2], vilari [6], and kaikkilai [3]."[62] This is extremely useful information, but the most dramatic insight to be gleaned from the Tamil version of pentatonicism is the provisional equation of each of the Tamil pentatonics with a "parent" heptatonic. This may be no more than a local interpretation of pentatonicism, but it runs counter to the general conception of pentatonic scales as (a) relatively indifferent to final and (b) conceived as a series of equivalent steps. And, consistent with general Indian modal practice, each of the five authorized pentatonics would be further particularized by its own distinctive modal features.[63]

We have much to learn about the various dialects of Asian pentatonicism, and the Indian versions have not been as well studied as those situated farther to the East and Northeast. I see this as a priority. The antiquity and wide distirbution of pentatonic scales have led many to conclude that scalar expansion, as from pentatonicism to diatonicism, is the standard or even universal process in world musics. Indian pentatonicism, including the present Tamil version, is in every case of which I am aware the result of a process of selection from a heptatonic base. The role of the pentatonics in early Tamil music can only have been enhanced by the extraordinary significance of fiveness in Tamil geography, climatology, botany, zoology, sociology, poetics, and other aspects of Tamil culture (see Example 6).

Twelve Propositions

What can the Tamil system teach us about the early history of scales and modes? I would like to frame my answer in the form of twelve propositions-tentative conclusions that I have reached on issues that merit further exploration. These are the lessons as I see them:

First, diatonic and pentatonic are not necessarily separate orders, as many scholars have seen them, with separate generating procedures and directions-that is, the downward "cascading" tetrachords of the ancient Mediterranean and Indo-Iranian world as opposed to the ascending acoustical fifths of East Asia.[64] Nor is pentatonicism, in this case, a prior link in the evolutionary chain that leads eventually to diatonicism. The evidence here supports neither the contention of many Central and Eastern European musicologists that anhemitonic pentatonicism represents, as Bence Szabolcsi put it, "*a*

consensus gentium, which at its most primitive level was probably once shared by the whole world,"[65] nor Joseph Yasser's hypothesis that diatonic scales have their origin in pentatonicism.[66] As I have pointed out above, the Tamil pentatonics appear to have been derived by selection from a diatonic base.

Second, the Tamil system confirms the complete numeric pathway through the set of nested pitch collections I have identified; from 22 to 12 to 7 to 5, apparently the only such pathway to survive in the musical records of early civilizations. The numerical properties of 22 deserve further investigation, not so much because this number may turn up elsewhere in the world but becaue of its prominence in the early history of the music of some twenty percent of the world's people.

Third, and this is a tricky but crucial point, scale degrees can be authorized, not necessarily by matching or approximating certain fixed positions, but by falling within a certain band of tolerance, within which there can be considerable variation-which may be to say that scale steps are bands, not points (as the Greeks thought), and that melodic intervals consequently are neither as precise or as meaningful as Western musicians have assumed them to be. As I once heard a great Indian musician say, "A note is not a point. It is a region to be explored." In traditional Indian musical thought, a scale step is manifested after reaching the upper edge of its "band", when a sufficient number of microtones have accumulated.[67] Perhaps "to be a note" means to fall within a specified range, not to hit a precise mark.

Fourth, we have seen what appears to be a universal phenomenon when, in seeking to close a diatonic pitch system generated by perfect fifths, sooner or later a tritone appears (as it did in generating the modes of the Old Tradition). This seems to get everyone's attention and calls for action-and often a bit of fudging, a temptation to which our discipline has often been prone.

Fifth, rotation (of one sort or another) appers to be a universal tactic of modality and one of the basic operations in what I have called phase two. What I find especially interesting about rotation is that its products seem never to be fully or equally employed. Pleasure is more selective.

Sixth, the Tamil system has reinforced my hunch that mixolydian and dorian are the proto-diatonic constructions, perhaps because of (among other things) the balance of whole steps, perfect fourths, and perfect fifths above and below their nodal degrees. This is not to say that our ancestors were groping toward proto-major and proto-minor tonality-that is entirely a recent Western way of looking at it.Phrygian, on the other

hand, seems always to be a special case-essential for variety, at times even preferred, but isolated and hard to explain. What we have encountered in the Tamil system is a set of five basic modes-four familiar diatonic constructions and one pentatonic. I have not heard of this combination anywhere else.

Seventh, we have seen additional evidence that modes have been described with spatial and temporal connotations, as well as other cultural flavors such as the astral connections and the grid of cultural coordinates reproduced in part in Example 6. There is evidence of similar thinking in early medieval European music treatises, but it seems to have been largely suppressed by the fathers of the Church-for both political and theological reasons. I would welcome the opportunity to hear the various genres of Western chant perfomed with some of the intensity, ethnic color, and emotional pathos of the repertoires from which their modal systems were assembled.

Are there some further lessons we can learn about the scales and modal systems of early Western music? Perhaps these:

Eighth, music theorists might do well to shed some of their faith in numbers. Music can be numbered but is not number. The mathematicians of ancient India were fully as sophisticated as their contemporaries around the eastern Mediterranean rim, but they were under no illusion that numbers were the key to ultimate reality. Numbers always retain their technical properties, which have a magic of their own, but they carry no divine authority for music. We should especially misturst claims on behalf of exact tunings. I am not arguing that people cannot hear and perform very small intervals with great exactness; I *am* arguing that these microtonal traditions are always local and subject to no general laws. In practice (and especially in vocal practice), most scales dissolve into individual shadings and variations-not only of pitch, but also of timbre, intensity, and vibrato. In melody, pitch is not a self-sufficient domain. And music theory will continue to depend upon approximations, of which a recent example is the application of "fuzzy logic" to pc-set theory.[68]

Ninth, the pattern of *relative* step sizes brings us closer to the ways in which humans organize their sounds. I have pointed out here and elsewhere that India does not have and never has had a fully developed concept of interval.[69] In the Asian modal systems with which I am familiar, melodies are conceived as sequences of fixed degrees, not intervals that retain their identity under transposition. In melodic music that is unsupported by a system of harmony, thirds and sixths are particularly "fuzzy" and sevenths are virually unknown. Perfect intervals and steps are the building blocks of

melody, with perfect fourths and fifths at nodal points and a wide variety of steps-wider perhaps than we are prepared to admit.[70] And as for their tuning, not all steps can be or need to be divided, and equidistant steps can work very well in cultures such as Indonesia where the relative permanence of bamboo and metal bars and gongs and the evenness of their physical pattern seems to have encouraged a spectacular ability to resist the charms of diatonicism. If we renounce some or all of our faith in the concepts of interval and interval class, we call into question many of our basic assumptions about consonance and dissonance, concepts that are weak to non-existent in certain melodic repertoires.

Tenth: But there is something about diatonicism that seems to satisfy our contradictory desires for pattern flexibility and unambiguous tonal orientation. The 9:8 and 10:9 whole tones of just intonation represent only one among many versions of diatonicism. In my hypothetical divison of scale-building into two phases, phase one clearly prefers dissimilar steps; phase two, where modality begins, prefers similar stpes in a trade-off between subtlety and flexibility. Part of what music theorists do, I am afraid, parallels what polyphonic music and movable type have done to early Western melody-steamrolling over minute inflections of pitch, time, color, intensity, and ornament in search of synchronization and uniformity, a uniformity that makes music easier to manipulate but for which we have paid a price.

Eleventh, scale-building-like evolution-seems to operate by natural selection, which means blind alleys, endangered and disappearing species, viable systems for which no music has survived, and "fossils" that are difficult to explain. No doubt we hear many of these fossils in some world musics today. A scale that ancient Indian musicians described but dismissed as being singable "only in heaven" may have turned up in Indonesia (the scale known as *pelog*)[71] I do not know if we are justified in reagrding the Tamil system as a "missing link," but it does provide unique evidence for some of the claims I have been making.

And finally, the modes of India and of many other Aisan cultures remind us that obsession with final has been an acquired taste in the West. With respect to early music, axial-not final-is the basic modal function. Tonal gravitation toward a ground tone and insistence on closure are not universal preferences. If we want to see what Gregorian chant has in common with other early modal systems, we should look first at the office chants, in which the reciting tones are stronger than the finals.

Part of our job as music theorists is to recognize the raw nature of the world of musical pitch that we are constantly working to tidy up. I am not suggesting that we should ease up in our attempts to formalize the material that we work with, but I have the feeling that we often accept without question some of the crucial assumptions on which we construct our theories. We can all profit from the occasional reminder that the world of pitch is not as neat as we would like it to be.

To return the focus of this article to the fragile music of ancient South India, I will let the author of the *Cilappatikaram* have the last word:

Text 5 (epilogue 1-14)

Here ends the *Cilappatikaram.* It ends, in truth,
With the story of Manimekalai. Like a mirror
Reflecting the far hills, it reflects the essence
Of the cool Tamil country, enclosed by the Kumari
And Venkatam, and by the eastern and western seas.
It comprises the five landscpe of pure and impure Tamil
Where live gods and humans following their duty
And practicing virtue, wealth, and love.
Its noble language expresses in perfect rhythm
Good sense, the themes of love and war.
Exquisite songs, the lute, musical mode, chants,
Drama, acts and scenes, dance
That conform to the established rules of the vari
Round dance and cetam, put in simple and perfect Tamil.

Abstract

In this article I revisit some of the basic questions, hypotheses and arguments about scale-building in world musics, drawing upon recent interpretations of the modal system of the early Tamil people of South India, as set forth in their national epic, the *Cilappatikaram* (fifth century C.E.?). The body of the paper consists of an exposition of the Tamil modes, their generation, tuning, rotation and their pentatonic derivatives. Among the distinctive features of the Tamil system is the circular projection of the modes along the twelve houses of the Zodiac, which allows us to examine the unique nesting of 22, 12, 7 and 5 divisions of the octave and infer their tuning. Further local color is provided by the cultural connotations of the five principal modes, which are mapped across a grid of five landscapes, times of day, seasons of the year, phases of

love, sources of water, flowers, beasts and the like. Mode in music thus encapsulates all the flavors and colors of Tamil civilization. The article concludes with twelve observations on what the Tamil system can teach us about the early history of scales and modes.

* Reprinted from Music Theory Spectrum, The Journal of the Society for Music Theory, Vol. 22, No. 2 (2000).

Foot Notes

The Original version of this article was first presented at the Eastman School of Music on 4 October 1996 as part of a lecture series celebrating the seventy-fifth anniversary of the founding of the School. This study is dedicated to my good friends Bob Gauldin and Bob Morris, from whom I have learned a lot.

1. For further information on the music of ancient India and Sanskrit treatises on music, I shall refer frequently to Lewis Rowell, *Music and Musical Thought in Early India* (Chicago, University of Chicago Press, 1992; New Delhi: Munshiram Manoharlal, 1998).

2. *The Cilappatikaram of Ilanko Atikal,* Trans. and ed. R. Parthasarathy (New York: Colombia University Press, 1993). All subsequent text references are from this edition unless otherwise identified. Readers should be aware that Parthasarathy's lines differ slightly in their numbering from the original Tamil. For further discussion and references, see below and notes. 5-18.

3. John Clough, Jack Douthett, N. Ramanathan and Lewis Rowell, "Early Indian Heptatonic Scales and Recent Diatonic Theory," *Music Theory Spectrum* 15/1 (1993): 36-58; Robert Gauldin, "The Cycle-7 Complex: Relations of Diatonic Set Theory to the Evolution of Ancient Tonal Systems," *Music Theory Spectrum* 5 (1983): 39-55.

4. Gauldin, "The Cycle-7 Complex," 53.

5. Hereinafter abbreviated as C.

6. C 21: 49-77; Parthasarathy (12) mentions that the Amazons of ancient Greece, as their name implies (*a* + *mazos* = without breast), reportedly removed a breast for greater freedom in combat.

7. Ibid., 5-6.

8. For analysis of the epic, Tamil metrics, poetics, and other valuable background information, see Parthasarathy, 1-16, 279-369.

9. Ibid., 6.

10. Ibid., 318.

11. See notes 15 and 18; See also Parthasarathy, 297-99,. 348-50.

12. For the Sanskrit sol-fa syllables, see Rowell, *Music and Musical Thought,* 78-80.

13. S. Ramanathan [1917-1988], *Music in Cilappatikaram* (Madurai: Madurai Kamaraj University, 1979).

14. Parthasarathy, 346.

15. *Cilappatikaram of Ilanko Atikal,* with the Arumpatavurai and the commentary of Atiyarkkunallar, ed. U.Ve. Caminataiyar (Madras: Sri Tiyakaraca vilacaveliyitu, 1892).

16. For details, see Parthasarathy, 385-89.

17. Margaret Bastin, "Vattapalai: A Study" [in Tamil] (M. Phil. thesis, University of Madras, 1990). I am grateful to Professor N. Ramanathan, Head of the Department fo Indian Music, University of Madras, for his kind assistance with the present article and other studies over the last twenty years.

18. There is no easy way to compare parallel passages from the *Cilappatikaram and its commentaries,* as presented in Parthasarathy's translation and S. Ramanathan's study (see notes 2 and 13), not only because of the unavoidable differences in line numbering in the former's English translation, but also because Parthasarathy has drawn liberally on the commentaries in preparing his translation - too liberally for my taste. S. Ramanathan has selected the main references to music and dance from both the main text and the commentaries, which he has then divided into 156 "texts" (from a few words to a paragraph each) and presented in two versions: (1) a free English translation (107-28), and (2) an extremely valuable interlinear translation that combines a word-for-word Tamil transliteration with the literal English meanings (131-77). The problem is compounded by Ramanathan's decision to

rearrange these texts into a topical order that matches his exposition of the material. I have attempted to solve the problem in two ways: first, by giving only page references to S. Ramanathan's study in the following notes; and second, in the case of the five English passages on which the present article is based (Texts 1-5), I have supplied both canto and line numbers from Parthasarathy's translation (in parentheses following each caption) and the relevant "text" numbers from S. Ramanathan's study (underneath each translated passage). Readers should bear in mind that the latter include excerpts from the main text and both commentaries. I have chosen (with some misgivings) to follow the Tamil transliteration protocols in Parthasarathy's translation, which differ considerably from the systems followed by S. Ramanathan and other Tamil scholars.

19. As heard on the open strings of the yal, which correspond to the basic scale palaiyal (see Examples 4, 5, and 7).

20. Text 1, line 136 and Text 2, line 39; the Tamil text of the latter passage reads "from ulai to kaikkilai" (see Example 3).

21. See note 12; I have included provisional translations of the Tamil names for the notes in Example 3 but, in most cases, the connections between the notes and their names remain obscure.

22. I have pointed out above that the original text of C contains only the Tamil names for the scale degrees, for which Parthasarathy has submitted the Sanskrit sol-fa syllables given in the commentaries. Atiyarkkunallar mentions also the intriguing possibility of linear, triangular, and quadrangular projections of the musical scale, but it is hard to imagine what these might be.

23. For the scales and modes of ancient India as present in Sanskrit treatises, see Rowell, *Music and Musical Thought,* 77-85, 145-79.

24. See Clough et al., "Early Indian Heptatonic Scales," 46-48.

25. See ibid., 38-41.

26. See below for further discussion of scale generation procedures.

27. Anne Draffkorn Kilmer, Richard L. Crocker, and Robert R. Brown, *Sounds from Silence* (Berkeley, Calif.: Bit Enki Publications, 1976), 7-11.

28. For the Tamil pentatonics, see Example 8 and the accompanying discussion.

29. More elaborate versions of the cultural coordinates displayed in Example 6 appear in the following studies: *The Interior Landscape: Love Poems from a classical Tamil Anthology,* trans. A.K. Ramanujam (Bloomington: Indiana University Press, 1967), 107; *Poems of Love and War from the Eight Anthologies and the Ten Long Poems of Classical Tamil,* trans. A.K. Ramanujan (New York: Columbia University Press/UNESCO, 1985), 242; and Kamil V. Zvelebil, *The Smile of Murugan: On Tamil Literature of South India* (Leiden: Brill, 1973), 100.

30. See S. Ramanathan, *Music,* 12, and his Diagram 6.

31. See the final two sections of this article for further discussion of modal functions.

32. These diagrams have been adapted from those given in S. Ramanathan, *Music,* 61-71, and amplified.

33. For information about early Indian astronomy, see C.R. Kay, *Hindu Astronomy* (1924; reprint, New Delhi: Cosmos Publications, 1981) and A.L. Basham, *The Wonder That was India* (New York: Macmillan, 1954), 489-91.

34. See below for further discussion of the tuning problem.

35. The *jatis* and *gramaragas* are discussed in Rowell, *Music and Musical Thought,* 168-79.

36. Matanga's projection (Brhaddesi 1:44-47) is discussed in Rowell, *Music and Musical Thought,* 152.

37. On the important concept of sonance, see Rowell, *Music and Musical Thought,* 157-60. The Tamil version of consonance and dissonance is explained in the *Arumpatavurai's* gloss on 8:33 (S. Ramanathan, *Music,* 113): notes can be "paired" (i.e. octaves), "related by [perfect] fifth generation" (1, 5, 2, 6 and 3), "friendly" (the fourth note), or "enemies" (the sixth and third notes).

38. See Clough et al., "Early Indian Heptatonic Scales," 46-48; we have not yet come to five.

39. I am indebted to Jack Douthett for this observation.

40. For an excellent history and analysis of tuning proposals, I recommend Mayer Joel Mandelbaum, "Multiple Division of the Octave and the Tonal Resources of 19-Tone Temperament" (Ph.D. diss., Indiana University, 1961); the pros and cons of 19-tone and 31-tone systems are given on pp. 201-18 and 313-36. It is a pity that this valuable study have never been published.

41. For the *sruti,* see Rowell, *Music and Musical Thought,* 145-52; for the *mattirai,* see S. Ramanathan, *Music,* 12-17 and 101-102.

42. S. Ramanathan, *Music,* 12-17.

43. For the contributions of ancient Indian mathematicians, see Debiprasad Chattopadyaya, *History of Science and Technology in Ancient India: The Beginnings* (Calcutta: Firma KLM Private Ltd., 1986), 112-240.

44. Namely, the soft diatonic (8:7 + 10:9 + 21:20), the tonic diatonic (9:8 + 8:7 + 28:27), the tense diatonic (10:9 + 9:8 + 16:15), the even diatonic (10:9 + 11:10 + 12:11), and the ditonic diatonic (9:8 + 9:8 + 256:243). For the passage in question, see *Greek Musical Writings,* vol. 2, trans. and ed. Andrew Barker (Cambridge: Cambridge University Press, 1989), 306-14.

45. As, for example, when Bharata demonstrated the existence of the twenty-two *srutis* (in chapter 28 of his *Natyasastra)* by comparing the tuning of two vinas; for details of Bharata's celebrated experiment, see Mukund Lath, *A Study of Dattilam* (New Delhi: Impex India, 1978), 212-17.

46. See Rowell, *Music and Musical Thought,* 154-56.

47. Clough et al., "Early Indian Heptatonic Scales," 48.

48. For an extraordinary account of the political history of bell tunings in ancient China, see Lothar von Falkenhausen, *Suspended Music: Chime-Bells in the Culture of Bronze Age China* (Berkeley: University of California Press, 1993), 310-24.

49. See, in particular, John Clough and Jack Douthett, "Maximally Even Sets," *Journal of Music Theory* 35/1-2 (1991): 93-173; and John Clough, John Cuciurean, and Jack Douthett, "Hyperscales and the Generalized Tetrachord." *Journal of Music Theory* 41/1 (1997): 67-100.

50. Clough and Douthett, "Maximally Even Sets."

51. I am indebted to Jack Douthett for these calculations.

52. On the murcchanas, see Rowell, *Music and Musical Thought,* 153-54.

53. For a discussion of modal features in early Indian scales, see Rowell, *Music and Musical Thoughts,* 170-71.

54. S. Ramanathan, *Music,* 114 (Atiyarkkunallur on 3:26); in a similar passage (3:41-42), Atiyarkkunallur mentions eleven features by which a mode can be recognized while being elaborated: initial, [proper] order, final, fullness, deficiency, its own properties (!), high, low, medium, range, and quality. S. Ramanathan has omitted two of these from his list (114), but has correctly translated them in his word-for-word text (146).

55. See Rowell, *Music and Musical Thought,* 146-49, 152-54; and Clough et al; "Early Indian Heptatonic Scales," 38-39.

56. See especially 423d-425a.

57. See S. Ramanathan, *Music,* 112.

58. Their names are listed in S. Ramanathan, *Music,* 43-46.

59. See S. Ramanathan, *Music,* Diagrams 13-17; for an encyclopedic survey of the modern South Indian ragas, see Walter Kaufmann, *The Ragas of South India* (Bloomington: Indiana University Press, 1976).

60. For information on the *melakarta* system, see Bonnie C. Wade, *Music in India: The Classical Traditions* (New Delhi: Manohar, 1994), 82-87.

61. See Joseph Needham, Wang Ling and Kenneth Girdwood Robinson, *Science and Civilisation in China,* vol. 4. pt. 1 (Cambridge: Cambridge University Press, 1962), 157-76.

62. *Arumpatavurai* on 8:33 (S. Ramanathan, *Music,* 113).

63. See note 54.

64. See Bence Szabolcsi's essay on "Pentatonicism and Cultural History," in his *A History of Melody,* trans. Cynthia Jolly and Sara Karig (London: Barrie and Rockliff; 1965), 216-43.

65. Ibid., 217.

66. Joseph Yasser, *A Theory of Evolving Tonality* (New York: American Library of Musicology, 1932); for commentary, see Gauldin, "The Cycle-7 Complex," 46-47.

67. This is why the musical examples in this article have been notated with microtones below the lowest scale step; for further explanation, see Rowell, *Music and Musical Thought,* 145-52.

68. See, for example, Ian Quinn, "Fuzzy Extensions to the Theory of Contour," *Music Theory Spectrum* 19/2 (1997): 232-63.

69. See Lewis Rowell, "Early Indian Musical Speculation and the Theory of Melody," *Journal of Music Theory* 25/2 (1981): 228-29.

70. And including (in certain systems and repertoires) intervals we might under other circumstances identify as skips.

71. See Clough et al. "Early Indian heptatonic Scales", 39-40.